MARINE BIODIVERSITY
STATUS, OPPORTUNITIES AND CHALLENGES

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ज्ञान - विज्ञानं विमुक्तये

MARINE BIODIVERSITY AND CONSERVATION OF THE IMPORTANT MARINE ORGANISMS

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Abstract

The major protected marine organisms belonging to elasmobranchs, marine mammals, turtles, molluscs, corals, gorgonids and holothurians. A total of 10 species of elasmobranchs, 5 species of turtles, were under the list of protected animals. Among the total 1700 species of marine fishes, 189 are pelagic and 150 are deep water, 830 are reef associated and about 43 belong to threatened groups and 270 belong to the dangerous category. There are 38 marine and costal protected areas including nine National parks and 25 wild life sanctuaries and four biosphere reserves. Marine and coastal ecosystems in India is complex and comprises of rivers, estuaries, lakes, backwaters, salt marshes, rocky shores, sandy shores, coral beds, sea grass areas, seaweed beds, mangroves and tidal grooves. Three gulfs i.e., Gulf of Mannar in the east coast, Gulf of Kutch and Gulf of Kambath along the west coast. Two Island systems Lakshadweep and Andaman and Nicobar Islands add to the biodiversity of India. The need for the protection of marine organisms was emphasized.

Introduction

The conservation of biological diversity, its sustainable use and the equitable sharing of its benefits are the main objectives of the convention on Biological Diversity. It seems that human activities are the immediate causes for the loss of biological diversity and the solutions and remedies are lying in the human behaviour. The term conservation and protection covers a large variety of practices. They may be used interchangeable or with different meanings depending on the situation. This makes lot of confusion to the debate. But in strict sense conservation is an approach that considers the long term variability of ecosystems within the context of resource and environmental projects. Conservation involves a concept of protection that does not prevent humans from intervening in natural processes. The term protection is reserved for operations aimed explicitly at safeguarding environments or species endangered by human activities.

The convention on Biological Diversity (CBD) recommends the conservation of ecosystem through policies for protected areas and sustainable management. Excerpts from the Article 8 of the Convention on Biological Diversity: in situ conservation promote the protection of ecosystem and the maintenance of viable populations of species in natural surroundings. In India we had several species of organisms belonging to different groups constitute the protected marine organism. Majority of the protected marine organism belonging to elasmobranchs, dolphins, whales, sea cow, turtles, molluscs, corals, sponges holothurians and gorgonids.

Elasmobranchs

The elasmobrachs consists of sharks, sawfishes (Pristiformes), rays, skates (Rajiformes) and guitar fishes (Rhinobatiformes). They are fished using different types of gears and in recent years have assumed great significance in the export market. They are exploited by a variety of fishing gears like gillnets, longlines and trawls along the Indian coast by both traditional and mechanised sector. Though there is no directed fishing for elasmobranchs in certain places of Tamilnadu, large meshed bottom set gillnets called as 'thirukkuvalai' are operated for fishing the rays (thirukku) (Raje *et al.*, 2002).

With increased demand both in the domestic and export markets and with availability of improved technology of fishing, the landings of these fishes have been increasing and reached the level of 70,000 t per year. The centre wise and gear wise landing statistics are collected regularly by C. M. F. R. I. from 1950 onwards from all along the coast. Detailed information on species composition and length and other aspects of biology generated at major landing centres like Veraval, Mumbai, Mangalore, Calicut, Cochin, Neendakara, Tuticorin, Mandapam and Vishakapatanam are suitably weighted to obtain estimates at the state level and finally to all India picture. The total catch of elasmobranchs during 1950-61 periods was about 25,000 t. In India, good elasmobranch fishery exists along the coast of Gujarat, Maharashtra and Kerala on the west coast and Tamilnadu and Andhra Pradesh along the east coast. During 1980-1990 Gujarat showed an increase of targeted fishery for whale shark. Later whale shark was included in the list of protected animals by the Wildlife Protection Act to stop the exploitation of the species.

Elasmobranchs are successful marine organisms over an enormous span of time, form the upper Devonian to present. When mass extinctions have occurred in the late Devonian period the elasmobranchs survived like phoenix and evolved enormously, whereas the other groups became extinct or insignificant (Agnatha–jawless fishes extinct, Placodermi-Acanthodi Marine and freshwater) (Mesozoic marine invasion of reptiles-sea crocodiles, placodonts, plesiosaurus, flying reptiles-extinct or remain insignificant). The elasmobranch showed marked refinement of morphology from upper Devonian to the present, paralleling the progress of bony fishes. Modern species exhibit advanced characters like placental reproduction, live birth, homoeothermic, very large brain and sophisticated sensory organs. They are all predatory feeding on wide range from zooplankton to benthic invertebrates, bony fishes, other sharks, turtles, seabirds and marine mammals.

Elasmobranchs includes about 60 families, 189 genera and some 1200 living species. They are comprised of 34 families and 500 species of sharks, 23 families and 650 species of batoids (ray, skate, guitar fish and sawfish) and 3 families and 50 species of chimaeroid fishes in the world. In India, we have listed out about 110 species of elasmobranch which includes 66 species of sharks and 44 species of batoides. Recent description of new

records and new species may lead to this figure to about 150-170 species from Indian coast alone (Raje *et al.*, 2002, Raje and Joshi, 2006).

Among elasmobranchs sharks have an unusual combination of biological characteristics like slow growth, delayed maturation, long reproductive cycles, low fecundity and long life spans.

1. Slow growth and delayed maturation

Generally elasmobranchs have been considered slow growing animals but as in other fishes rate of growth (cm/yr) decreases continually as the individual ages. Amount of growth occurring in a shark population, averaged over the individuals in the population, then the growth may be considered quite slow. Because sharks have low natural mortality and high longevity, so that there are many old, slow growing individuals in the population. Thus the production in the shark population tends to be slow at the same time individuals show high growth in the early years.

2. Long reproductive cycles

Shark produces young that hatch or are born in a fully developed which are relatively large at birth. The energy needed to produce large, fully developed young results in great energy demands on the females to have long reproductive cycles and gestation periods of one or two years in most species. The reproductive cycle is how often the shark reproduces and it is usually one or two years long. The gestation period is the time of embryonic development from fertilisation to birth and is one or two years long. The reproductive cycle and gestation period may run concurrently or consecutively and both last two years. Shortlyafter parturition it mates and ovulates again and is biennial.

3. Low fecundity

The number of young or "pups" per brood usually ranges from two to a dozen.

4. Long life span

Many species of sharks are known to be long-lived. The *Squalus acanthias* have 65-70 years, *Carcharhinus leucas* 27 years and *Myliobatis* 23 years.

5. Life histories in the Elasmobranchs

Most obvious character to study and related to consumption, mortality

rate and rate of population increase. The largest shark is the whale shark, *Rhincodon typus* (2000 cm) and the smallest squaloids and poroscyllids about 20 cm. Most commercially important sharks measuring a meter or two at full size. Among grey sharks female grows larger sizes than males. Most of the elamobranchs are born or hatched in a well-developed manner. Majority of the large sharks are slow to mature. The shallow coastal waters are known as 'nurseries' to give birth to their

young and young spend their first months or years. Most of the commercially important species that is *Carcharhinus, Sphyrna, Rhizoprionodon, Negaprion* have shallow water nurseries. These sharks are very vulnerable to modern fishing operations and are easily overfished.

6. Ecomorphological diversity

Elasmobranchs are more divers in ecology and behaviour than agnaths and tetrapods. They live in surface, continental slope, below 3000 m, tropics, lakes, rivers, Arctic and Antartic Sea. They occupy all the realms of the pelagic, benthic, oceanic, deep water and littoral (fresh water) habitats. They have a variety of form and activities.

7. Reproduction

Elasmobranch follows different modes of reproductive strategies.All sharks are iteroparous(reproducing more than once) rather than semeplarous (producing all their young at one time) (Table 1).

Table 1. Maximum length, max size at birth, number of young ones and growth rate (K) of some of the elasmobranchs

Species	Maximum size (cm)	Max. Size at birth (cm)	Number of Young ones	K (growth rate)
Alopius vulpinus	491	151	4	0.367
Alopius superciliousus	450	105	2	0.266
Carcharodon carcharias	594	110	7	0.205

Isurus oxyrhynchus	364	80	16	0.248
Carcharhinus amblyrhynchos	255	60	6	0.268
C. limbatus	180	60	10	0.278
C. longimanus	270	75	10	0.325
Galeocerdo cuvieri	550	85	55	0.168
Spyrna lewini	560	70	11	0.133

Protected Elasmobranchs

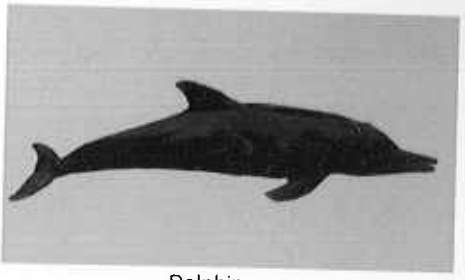
Whale shark –*Rhincodon typus*

Whale shark is huge, sluggish, pelagic filter-feeder, often seen swimming on the surface (Fig.1). Viviparous and gravid female have 300 young ones of several stages of development (Silas, 1986, Raje *et al.*, 2002). List of protected elasmobranchs are given in the Table . 2.

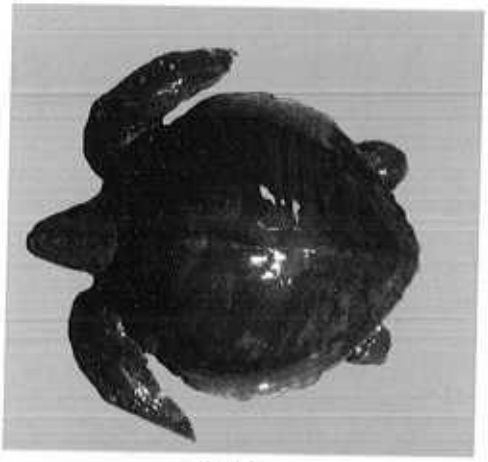
Table 2. List of protected elasmobranchs as per the Wildlife (Protection) Act, 1972 Schedule I

Species	Common name	Maximum size (cm)
Rhincodon typus	Whale shark	2000
Anoxyprisits cuspidate	Pointed sawfish	470
Prisits microdon	Largetooth sawfish	700
Prisitis zijsron	Longcomb sawfish	730
Carcharhinus hemiodon	Pondicherry shark	200
Glyphis gangeticus	Ganges shark	204
Glyphis glyphis	Speertooth shark	100
Himnatura fluviatilis	Gangetic stingray	100
Rhyncobatus djiddensis	Giant guitarfish	310
Urogymnus asperimus	Thorny ray	147

Whale shark



Dolphin



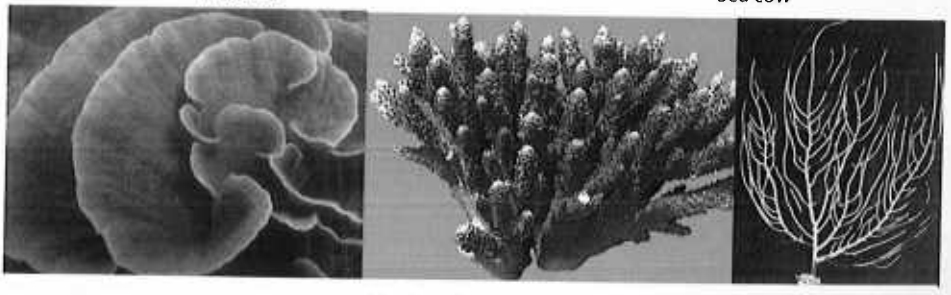
Turtle

Sea horse

Conus

Tridacna

Sea cow



Hard corals

Sea fan

Marine Benthic Diversity – The Indian Context

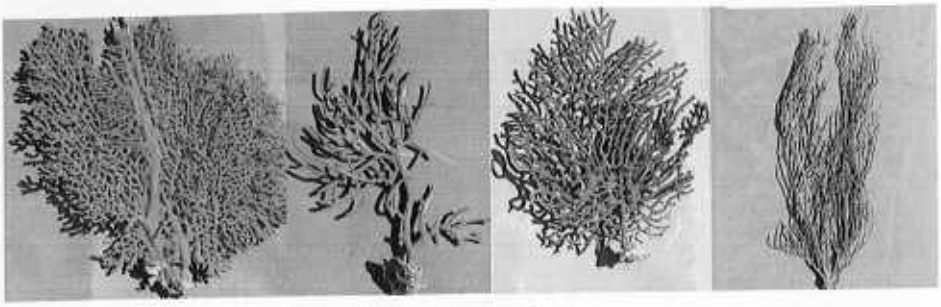


Fig. 2. Diversity of gorgonids

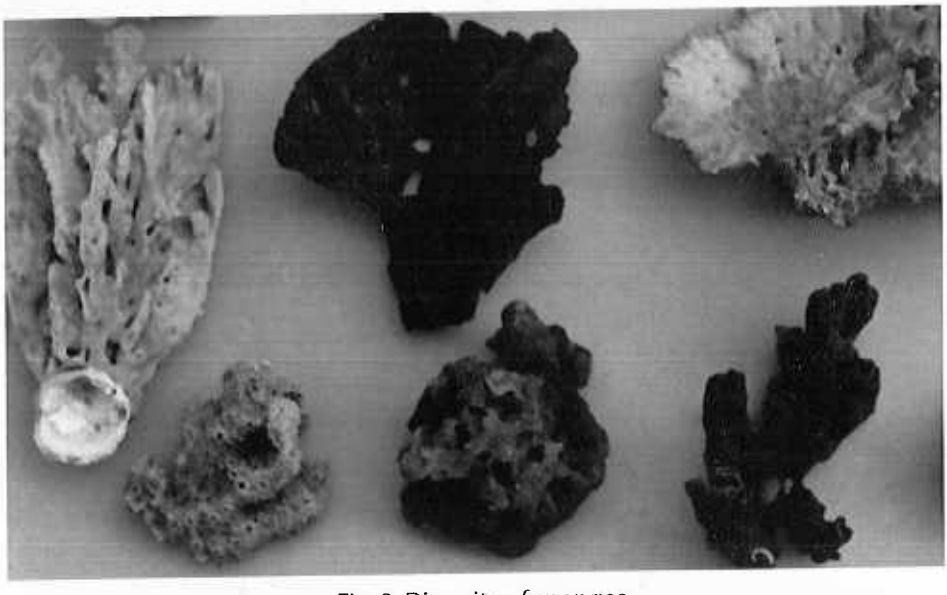


Fig. 3. Diversity of sponges

Dolphins

C.M.F.R.I. has been reporting the Dolphin stranding all along the coast over the last four decades. The reports containing the scientific name of the species, locality, morphometric parameters and photographs. The reports shows that Dolphin straddling observed from Gujarat coast West Bengal coast and showing an insight to the distribution of dolphins along the Indian coast. The species diversity of dolphins in India is one among the richest in the world. A total of five species dolphins were recorded from our seas. They are *Stenella longirostris* (Spinner dolphin), *Sousa chinensis* (Humpback dolphin), *Delphinus delphis* (Common dolphin), *Tursiops truncatus* (Bottle nose dolphin) and Rissos dolphin (James, 1985).

Whales

Whales constitute the most dominant groups of marine mammals. They usually occupy in the temperate and polar oceanic waters, they migrate to tropical waters for breeding and avoid extreme climatic conditions during certain seasons. Body of whale is protects them from thermal changes, store of energy for migration and helps in maintaining the buoyancy. Whales are classified into Odontoceli (toothed whales) and mysticeli (baleen whales). All the Cetaceans are included in the list of protected animals.

1. *Physeter macrocephalus* Linnaeus

The length range was 3.7 to 17.4 m and weight range from 0.7 to 65 t and length at birth was 5 m. The 'Ambergris', a derivative from this whale is found in the intestine and is used in the perfume and cosmetic industry.

2. *Kogia breviceps* Blainville

Rare species in Indian waters and rare in strandings.

3. *Ziphius carvirostris* Cuvier

The snout pointed to a toothed beak, grows up to 10 m

Over the years C.M.F.R.I have been recorded the stranding of 55 whales from different location all along the Indian coast. The reports contain the species name, body measurements, photographs and name of locality. A total of about 10 species have been reported from Indian seas. They are *Indopacetus pacificus* (Longmans beaked whale), *Balaenoptera borealis, B. Musculus, B. acutorostrata, Pseudocra crassidens, Pysester macrocephalus, Ziphius carvirostris* and *Balaenoptera sp.*

Sea Cow

The sea cow, *Dugong dugon* inhabits in the Gulf of Mannar and Palk bay area and is included in the List of protected animals as per the Wildlife (Protection) Act, 1972 Schedule I (Silas and Bastian, 1988).

Turtles

Five species of sea turtles were reported In India which include, Olive Ridley (*Lepidochelys olivacea*) Green Turtle (*Chelonia mydas*), Leather back (*Dermocheylus olivacea*), Hawksbill (*Eretmocheylus imbricata*) and Logger head (*Caretta caretta*). CMFRI has developed a national research programme and surveyed the nesting grounds along the Indian coast, monitored their incidental catch and strengthened the National Resource Data of turtles (Silas, 1984; Silas, *et al.*, 1983). All the five species were included in the list of protected animals as per the Wildlife (Protection) Act, 1972 Schedule I.

Marine Molluscs

C.M.F.R.I. has done excellent work on the marine molluscs of India on the taxonomy, distribution and mariculture of commercially important species. A total of 3271 species of molluscs distributed among 220 families and 591 genera, of which 1900 are gastropods, 1100 bivalves, 210 cephalopods, 41 polyplacophores and 20 scaphopods. Among these 8 species of oysters, 2 species of mussels, 17 species of clams, 3 species of pearl oysters, 3 species of giant clams, 1 species of windo-pane oyster and gastropods such as Sacred Chank, Trochus, Turbo and 15 species of Cephalopods are exploited from the Marine sector of India. List of protected marine molluscs as per the Wildlife (Protection) Act, 1972 Schedule I are *Cassis cornuta, Charonia tritonis, Conus millneedwardsi, Cypraecass rufa, Nautilus pompilus, Hippopus hippopus, Tridacna maxima, Tridacna squamosa etc* are the some of the molluscs protected the Wildlife (Protection) Act, 1972 Schedule I.

Corals and Gorgonids

List of protected Corals and gorgonids as per the Wildlife (Protection) Act, 1972 Schedule I

1. Reef building coral (All Scleractinians)
2. Black Coral (All Antipatharians)

3. Organ Pipe Coral (*Tubipora musica*)
4. Fire coral (All Millipora Species)
5. Sea Fan (All Gorgonids)

Other Marine Organisms

The Sea horses, Sygnathidians, holothurians are included in the list of protected animals as per the Wildlife (Protection) Act, 1972 Schedule I.

Major Ecosystems of India

Marine and coastal ecosystems in India is complex and comprises of rivers, estuaries, lakes, backwaters, salt marshes, rocky shores, sandy shores, coral beds, sea grass areas, seaweed beds, mangroves and tidal grooves. Three gulfs *i e*, Gulf of Mannar in the east coast, Gulf of Kutch and Gulf of Kambath along the west coast. Two Island systems Lakshadweep and Andaman and Nicobar Islands add to the biodiversity of India. The two major ecosystems are Arabian Sea ecosystem and Bay of Bengal eco system. Besides these the subsystems like north west coast (Gujarat, Maharashtra), south west coast (Goa, Karnataka, Kerala) South east coast (Tamil Nadu, Andhra Pradesh, Pondicherry) and north east coast (Orissa, West Bengal) provides wide variety of habitats.

Important mangrove areas are Sunder bans, Bhitrakanika, Krishna and Godavari delta, Andaman and Niccobar Islands, Gulf of Kutch and Pichavaram- Vedharanyam areas. Sea grass occurs along the east and west cost of India and about 14 species are found in India. There are about 770 species of seaweeds found along the Indian coast. Five species of sea turtles found in Indian waters and their resting areas on the sea coast Gahrimatha Rushikulya and Devi river mouth in Orissa. 25 species of marine mammals are found in Indian waters. Sea cow (*Dugong dugon*) found in the waters of Gulf of Mannar. India has 38 marine and coastal protected areas (MCPA) including nine National Parks, 25 wild life sanctuaries and four biosphere reserves. The major MCPA along the coastline of India are from the fishing and fishery point of view and success

of all protection depend on the involvement of local people. There are about 4000 costal fishermen villages, nine lakh households and 3.5 million fishermen population in India.

The Arabian Sea, large marine ecosystem (LME) is characterized by its tropical climate. The continental shelf is widest off the North West coast of the India and this region has tropical cyclone storms. The Arabian Sea strongly influenced by monsoons. During the southwest monsoons the wind in the regions are from southwest enhances evaporation from the warm waters of Arabian sea and heavy rain fall along the coast and this is considered to be highly productive eco systems in the world.

Conservation of Marine Resources

The Government of India has brought into force a number of laws for conservation of living organisms and their habitats. There are several species of sponges and gorgonids occurring along the Indian coast which yields chemical compounds of econonimc importance. Indian Wild life Protection Act, 1972 with its subsequent amendments accords the protection to all the marine mammals, five species of marine turtles, 50 species of molluscs, nine species of elasmobarnchs, all species of seahorses, holothurians, gorgonids and corals. Various Marine Fisheries Acts (MFRA) were enacted by the maritime states of the country under a government of India order in 1979 aims to safeguard the marine resources through craft and gear regulation and licensing of fishing activity. Also the state governments impose ban on trawling lasting two months during monsoon to protect spawners and juveniles.

As per the provisions of the CBD, India enacted legislation of Biodiversity act and notified the Biodiversity rules, 2004. The act and rules are for guidance of and compliance by various stake holders, including Union and state governments, non-state sectors and individuals. The National Biodiversity Authority of India based at Chennai has state biodiversity boards have been set up under the provisions of the Act.

The C.M.F.R.I. under the ICAR had the most intensive network of monitoring marine biodiversity exploitation and is carrying out assessments of the exploited fish stocks to manage them in a sustainable

level. Among the total 1700 species of marine fishes, 189 are pelagic and 150 are deep water, 830 are reef associated and about 43 belong to threatened groups and 270 belong to the dangerous category. Marine fisheries of India is mainly supported few targeted species namely oil sardine, mackerel, anchovies, seerfish, ribbonfish, Bombay duck, carangids, elasmobranchs, sciaenids, perches, silverbellies, lizardfish, penaeid shrimps, cephalopods and bivalve molluscs. The Institute has assisted the Government of India in formulating a comprehensive Marine Fisheries Policy, rendered advice to maritime states in Coastal Zone Regulation (CZR) and guidelines on Biodiversity Policy. It has rendered policy advice on Lobster conservation, on denotification of ban on certain species of Elasmobranchs and molluscs by MOEF and also played role on the ban of endangered species of corals, sea cucumbers and ornamental gastropods.

References

Raje, S. G. and Joshi, K. K. 2003. *Elasmobranchs.* **In**: Status of Exploited Marine Fishery Resources of India. Mohan Joseph, M and Jayaprakash, A A, **(eds.)** CMFRI, Cochin, pp. 92-101. ISBN 81-901219-3-6

Raje, S. G. and Mathew, Grace and Joshi, K. K. and Rekha J. Nair and Mohanraj, G and Srinath, M and Gomathy, S. and Rudramurthy, N. 2002. *Elasmobranch fisheries of India - An appraisal.* CMFRI Special Publication, 71. pp. 1-76.

Silas, E. G. and Fernando, A . Bastian. 1988. *The dugong in India - is it going the way of the dodo.* In: Proceedings of the Symposium on Endangered Marine Animals and Marine Parks; MBAI, 12-16 January 1985, Cochin.

Silas, E. G. and Rajagopalan, M. and Fernando, A. Bastian. 1983. *Sea turtles of India - need for a crash programme on conservation and effective management of the resource.* Marine Fisheries Information Service, Technical and Extension Series, 50 . pp. 1-12.

Silas, E. G. 1984. *Sea tutle research and conservation- some problem areas.* CMFRI Bulletin, 35. pp. 1-8.

Silas, E. G. 1986. *The Whale shark (Rhiniodon typus Smith) in Indian coastal waters. Is the species endangered or vulnerable?* Marine Fisheries Information

Service, Technical and Extension Series, 66 . pp. 1-19.

James, P. S. B. R. 1985. *On the conservation and management of marine mammals of India.* In: Proceedings of the Symposium on Endangered Marine Animals and Marine Parks ; MBAI, , 12-16 January 1985, Cochin.